Papaya Mosaic Transmission as Affected by the Duration of the Acquisition Probe of the Green Peach Aphid-Myzus *persicae* (Sulzer)[1]

R. NAMBA AND S. Y. HIGA
DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF HAWAII
HONOLULU, HAWAII 96822

With nonpersistent viruses the transmission rates of the viruses are highest when the aphid vectors, after a period of fasting for several minutes, probe the virus source plant for about 10 seconds to a few minutes. As the duration of the probes increases beyond a few minutes there is a decrease in the transmission rates (Sylvester, 1954; Bradley, 1964). The point at which the decrease begins has not been clearly determined (Swenson, 1960). Actually very little detailed work has been done to ascertain the effect of the duration of the probe to acquire the virus on the transmission of nonpersistent viruses.

Bradley (1954) watched and timed the initial acquisition probes of 1500 green peach aphids on a potato virus Y source. These probes were naturally terminated and they lasted from 5 seconds to 1 hour. For probes of durations from 10 seconds to 5 minutes, the transmission rates were about the same but with an increase in the duration of the probes beyond 5 minutes there was a decrease in the rates, Swenson(1960), working with bean yellow mosaic and *M. persicae*, watched and timed the initial acquisition probes of 1526 aphids. Only probes from 11 to 60 seconds were considered. There was a slight decrease in the transmission rate when the probes lasted longer than 50 seconds. Studies by Watson (1938), Watson and Roberts (1939), and Kassanis (1941) showed decrease in transmission with increase in time when the aphids were confined with the virus sources for 2 minutes, 15 minutes, and 1 or 4 hours. These times, however, were periods when the aphids had access to the virus sources and not the actual periods they were in single acquisition probes. During the access periods an aphid could make multiple probes of varying durations (Sylvester 1954) so these results may not be comparable to those of single initial acquisition probes.

Herein is a report of the effect of the length of the duration of single initial acquisition probes of the green peach aphid on the transmission of the papaya mosaic virus. The range of the watched and timed probes was from 10 seconds to 30 minutes. The frequency distribution of the probes with regard to duration is also reported.

METHODS AND MATERIALS

The vectors used in the experiments were nonviruliferous late-instar apterae of *M. persicae*. The test plants were seedlings of cucumber, *Cucumis sativus* L. var. Colorado Long. The virus sources were detached

[1]Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Journal Series No. *2421*.

leaves of papaya, *Carica papaya* L. var. Solo, infected with papaya mosaic. The petioles of the detached leaves were kept in water during the tests to prevent wilting.

The aphids were fasted for at least 1/2 hour in glass vials prior to use in the tests. The initial probe of each aphid on the virus source leaf was watched with a hand lens and timed with a stopwatch. The timing of the probe was begun when the aphid assumed the probing position, i.e., the tip of the proboscis firmly appressed and perpendicular to the leaf surface, and ended when the proboscis was lifted off the surface. Aphids that were in the probing position for less than 10 seconds were discarded. In Series I the aphids were induced to terminate their probes at 5 minutes and in Series II at 30 minutes. This was accomplished by gently disturbing the aphids with a camel's-hair brush until they pulled their stylets out of the leaf on their own accord which took from several seconds to minutes.

After the probe on the virus source, the aphids were placed on test plants, one aphid per plant. The aphids were killed after about an hour and the test plants were placed in an insect-proof greenhouse until manifestation of papaya mosaic symptoms.

Results and Discussion

Data are presented in Table 1. In Series I the initial probes of 791 aphids on the virus source leaf were watched and timed. 60.6% of the probes

TABLE 1. *Transmission of the papaya mosaic virus by the green peach aphid after a single virus acquisition probe.*

Series	Duration of probes (in minutes to:)											
	1	2	3	4	5	7	10	15	20	25	30	30+
I[a]	86/432[c] (19.9)[d]	15/55 (27.3)	2/23 (8.8)	2/9 (22.2)	2/6 (33.3)	63/266 (23.7)						
II[b]	18/41 (43.9)	5/7 (71.4)	4/8 (50.0)	1/1 (100)	2/2 (100)	2/6 (33.3)	1/7 (14.3)	0/6	0/17	0/17	0/67	0/21

a = aphids induced to terminate their probes at 5 min
b = aphids induced to terminate their probes at 30 min
c = ratio is number of plants infected out of number inoculated
d = percent transmission

lasted less than 2 minutes and these probes, which are considered to be favorable for transmission of nonpersistent viruses resulted in a transmission rate of 20.7%. Probes of 5-7 minutes in Series I constituted 33.6% of the total and resulted in a transmission rate of 23.7%. The rate possibly could have been higher considering the aphids in probe at 5 minutes were artificially disturbed to terminate their probes. It is possible that this disturbance has the same effect as the artificial termination of probes which has been reported to lower the transmission rate of some nonpersistent viruses (Bradley, 1952; Sylvester, 1954). The numbers of probes of durations from 2 to 5 minutes were relatively low. The probles of 2 to 3 minutes duration resulted in a low transmission rate but those from 3 to 5 minutes had substantial transmission rates.

In Series II the initial probes of 200 aphids were watched and timed. 24.0% of the total number of probes were of less than 2 minutes duration and they resulted in a transmission rate of 47.9%. Probes of 5-7 minutes duration resulted in a transmission rate of 33.3%. The longest duration at which transmission occurred was 8 minutes 50 seconds. There were 130 probes longer than this maximum effective duration yet none of them resulted in transmission of the virus. Evidently, for this vector-virus combination, the maximum duration of a probe which would result in transmission is about 9 minutes. The number of probes from 1 to 7 minutes was relatively small but transmission rates were substantial.

In Series I it is uncertain that there is a decrease in transmission with increase in the duration of the acquisition probes because the aphids were induced to terminate their probes short of the apparent maximum effective duration for transmission. The results from Series II would indicate that if the aphids in Series I were not induced to terminate their probes at 5 minutes, many of them would have continued to probe for longer periods. Furthermore many of them would likely to have probed for longer periods than the maximum effective duration for transmission of the virus which, as in Series II, would probably be about 9 minutes. This would mean that the 63 transmissions recorded for probes of 5-7 minutes duration in Series I would probably have resulted from probes of less than 9 minutes and since it is likely that some probes out of the 266 recorded in the 5-7 minute category would be longer than 9 minutes, the transmission rates of the durations leading up to 9 minutes would be relatively high. The indication, therefore, is that there is no strong evidence of a decrease in transmission with increase in the duration of the acquisition probes. In Series II a decrease is shown with probes of longer duration than 5 minutes, but the number of probes in these durations is too low to be of much consequence. Thus the results of both Series I and Series II are not definitely supportive of the generalization that with nonpersistent viruses the transmission rate decreases with increase in the duration of the acquisition probes beyond a few minutes.

Literature Cited

Bradley, R.H.E. 1952. Studies on the aphid transmission of a strain of henbane mosaic virus. Ann. Appl. Biol. 39:78-97.

_____, 1954. Studies of the mechanism of transmission of potato virus Y by the green peach aphid, *Myzus persicae* (Sulz.) (Homoptera: Aphidae). Canad. J. Zool. 32:64-73.

_____, 1964. Aphid transmission of stylet-borne viruses. In: Plant Virology, ed. M.K. Corbett and H.D. Sisler. pp. 148-174. Univ. of Florida Press, Gainsville, Fla.

Kassinis, B. 1941. Transmission of tobacco etch viruses by aphides. Ann. Appl. Biol. 28:238-243.

Swenson, K.G. 1960. Aphid-virus relationships in the transmission of bean yellow mosaic virus by *Myzus persicae*. Ann. Entomol. Soc. Amer. 53:521-524.

Sylvester, E.S. 1954. Aphid transmission of nonpersistent viruses with special reference to the *Brassica nigra* virus. Hilgardia 23:52-98

Watson, M.A. 1938. Further studies on the relationship between Hyoscyamus virus 3 and the aphis *Myzus persicae* (Sulz.) with special reference to the effects of fasting. Proc. Royal. Soc. London, Ser. B, No. 838, 125:144-170.

_____ and F.M. Roberts. 1939. A comparative study of the transmission of Hyoscyamus virus 3, potato virus Y and cucumber virus 1 by the vectors *Myzus persicae* (Sulz.), *M. circumflexus* (Buckton), and *Macrosiphum gei* (Koch). Proc. Royal. Soc. London, Ser. B, No. 849, 127:543-576.